We claim:

1. A mid-infrared laser system for performing a laser surgical procedure on a tissue, said system comprising:

a laser source means for producing a pump beam having a wavelength ranging approximately from 1.0 to 1.1μm,

a nonlinear crystal for parametrically converting the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range corresponding approximately to an absorption peak of said tissue; and

means for directing said idler beam onto said tissue to remove portions of said tissue primarily by a photo-mechanical ablation process.

2. The laser system according to claim 1, wherein said laser source means is a neodymium-doped laser.

3. The laser system according to claim 1, wherein said pump beam has a pulse duration of less than 50 ns, and a repetition rate of at least 10 Hz and a transverse mode structure consisting of single or multiple modes.

4. The laser system according to claim 1, wherein said nonlinear crystal is a Potassium Titanyl Phosphate (KTP) crystal.

5. The laser system according to claim 1, wherein the nonlinear crystal is rotatable about three principal axes.

6. The laser system according to claim 1, wherein said nonlinear crystal is made of a periodically poled non-linear material including KTP and isomorphs or $LiNbO_3$.

7. The laser system according to claim 1, wherein said nonlinear crystal is tunable to optimize absorption in said tissue.

8. The laser system according to claim 1, wherein said idler beam has energy output of at least 1 mJ.

9. The laser system according to claim 1, wherein said idler beam achieves a thermal damage zone in corneal tissue of less than 2µm.

10. The laser system according to claim 1, wherein said surgical procedure is a corneal ablation procedure.

11. The laser system according to claim 10, wherein said corneal ablation procedure is a PRK technique based on a photospallation mechanism

12. The laser system according to claim 1, wherein said directing means includes three mirrors comprising an "L shaped" arrangement.

13. The laser system according to claim 1, wherein the nonlinear crystal is based on a doubly-resonant oscillator.

14. The laser system according to claim 1, comprising a pair of said nonlinear crystals pumped by said laser source means with interlaced beams whereby an overall repetition rate of at least 20 Hz is achieved.

15. The laser system according to claim 1, wherein the fluence onto the eye is between 100 mJ/cm^2 and 500 mJ/cm^2.

16. A mid-infrared laser system for performing a laser surgical procedure on a tissue, said system comprising:

a laser source means for producing a pump beam having a wavelength ranging approximately from 1.0 to 1.1µm,

a nonlinear crystal for parametrically converting the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range approximately between 2.85 and 3.0 µm; and

means for directing said idler beam onto said tissue to remove portions of said tissue primarily by a photo-mechanical ablation process.

Sub B1 17. A method for performing a laser surgical procedure on a tissue, said method comprising the steps of:

generating a pump beam having a wavelength ranging approximately from 1.0 to 1.1µm,

passing said pump beam through a nonlinear crystal to parametrically convert the pump beam into an idler beam and a signal beam,

said idler beam having a wavelength in the mid-infrared range corresponding approximately to an absorption peak of said tissue; and

directing said idler beam onto said tissue to remove portions of said tissue primarily by a photo-mechanical ablation process.

18. The method according to claim 17, wherein said laser source means is a neodymium-doped laser.

19. The method according to claim 17, wherein said pump beam has a pulse duration of less than 50 ns, a repetition rate of at least 10 Hz and a transverse mode structure consisting of single or multiple modes.

20. The method according to claim 17, wherein said nonlinear crystal is a Potassium Titanyl Phosphate (KTP) crystal.

Sub B2

21. The method according to claim 17, wherein the nonlinear crystal is rotatable about three principal axes.

22. The method according to claim 17, wherein said nonlinear crystal is made of a periodically poled non-linear material including KTP and isomorphs or $LiNbO_3$.

23. The method according to claim 17, further comprising the step of tuning said nonlinear crystal to optimize absorption in said tissue.

24. The method according to claim 17, wherein said idler beam has energy output of at least 1 mJ.

25. The method according to claim 17, wherein said idler beam achieves a thermal damage zone in corneal tissue of less than 2μm.

Sub B3

26. The method according to claim 17, wherein said surgical procedure is a corneal ablation procedure.

27. The method according to claim 26, wherein said corneal ablation procedure is a PRK technique based on a photospallation mechanism

28. The method according to claim 17, wherein said directing means includes three mirrors comprising an "L shaped" arrangement.

29. The method according to claim 17, wherein the nonlinear crystal is based on a doubly-resonant oscillator.

30. A mid-infrared laser system for performing a laser surgical procedure on a tissue, said system comprising:

a laser source for producing a pump beam having a wavelength ranging from approximately 0.85 to 0.9 μm;

a nonlinear crystal rotatable about three principal axes for parametrically converting the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range approximately between 2.85 and 3.0μm, wherein said nonlinear crystal is noncritically phase matched and said crystal is oriented such that phase matching is achieved along a propagation direction of said idler beam parallel to one of said principal axes; and

means for directing said idler beam onto said tissue.

31. A mid-infrared laser system for performing a laser surgical procedure on a tissue, said system comprising:

a laser source for producing a pump beam having a wavelength ranging from approximately 0.85 to 1.1µm, said pump beam having a defined polarization;

a nonlinear crystal for parametrically converting the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range between approximately 2.85 and 3.0µm;

fiber means for coupling said laser source to said nonlinear crystal, said fiber means maintaining said polarization; and

means for directing said idler beam onto said tissue to remove portions of said tissue primarily by a photo-mechanical ablation process.

32. A method for removing corneal tissue from an eye of a patient, said method comprising the steps of:

generating a pump beam having a wavelength of approximately 1 µm;

passing said pump beam through a nonlinear crystal to parametrically convert the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range corresponding to a corneal absorption peak; and

scanning said beam across an area of said corneal tissue in a predefined pattern to remove portions of said corneal tissue primarily by a photo-mechanical ablation process.

5064 33. The method according to claim 32, wherein said laser source means is a neodymium-doped laser.

34. The method according to claim 32, wherein said pump beam has a pulse duration of less than 50 ns, and a repetition rate of at least 10 Hz and a transverse mode structure consisting of single or multiple modes.

35. The method according to claim 32, wherein said nonlinear crystal is a Potassium Titanyl Phosphate (KTP) crystal.

36. The method according to claim 32, wherein the nonlinear crystal is rotatable about three principal axes.

37. The method according to claim 32, wherein said nonlinear crystal is made of a periodically poled non-linear material including KTP and isomorphs or $LiNbO_3$.

38. The method according to claim 32, further comprising the step of tuning said nonlinear crystal to optimize absorption in said tissue.

39. The method according to claim 32, wherein said idler beam has energy output of at least 1 mJ.

40. The method according to claim 32, wherein said idler beam achieves a thermal damage zone in corneal tissue of less than 2μm.

41. The method according to claim 32, wherein said surgical procedure is a corneal ablation procedure.

42. The method according to claim 41, wherein said corneal ablation procedure is a PRK technique based on a photospallation mechanism

43. The method according to claim 32, wherein said directing means includes three mirrors comprising an "L shaped" arrangement.

44. The method according to claim 32, wherein the nonlinear crystal is based on a doubly-resonant oscillator.

45. A mid-infrared laser system for removing corneal tissue from an eye of a patient, said system comprising;

a laser source means for producing a pulsed pump beam having a wavelength ranging approximately from 1.0 to 1.1μm;

a nonlinear crystal for parametrically converting the pump beam into an idler beam and a signal beam, said idler beam having a wavelength in the mid-infrared range corresponding approximately to a corneal absorption peak; and

means for directing said idler beam onto said eye in a predefined pattern to remove portions of said corneal tissue primarily by a photo-mechanical ablation process.

46. The laser system according to claim 45, wherein said laser source means is a neodymium-doped laser.

47. The laser system according to claim 45, wherein said pump beam has a pulse duration of up to 50 ns, and a repetition rate of at least 10 Hz and a transverse mode structure consisting of single or multiple modes.

48. The laser system according to claim 45, wherein said nonlinear crystal is a Potassium Titanyl Phosphate (KTP) crystal.

49. The laser system according to claim 45, wherein the nonlinear crystal is rotatable about three principal axes.

50. The laser system according to claim 45, wherein said nonlinear crystal is made of a periodically poled non-linear material including KTP and isomorphs or $LiNbO_3$.

51. The laser system according to claim 45, wherein said nonlinear crystal is tunable to optimize absorption in said tissue.

52. The laser system according to claim 45, wherein said idler beam has energy output of at least 1 mJ.

53. The laser system according to claim 45, wherein said idler beam achieves a thermal damage zone in corneal tissue of less than 2μm.

54. The laser system according to claim 45, wherein said surgical procedure is a corneal ablation procedure.

55. The laser system according to claim 54, wherein said corneal ablation procedure is a PRK technique based on a photospallation mechanism

56. The laser system according to claim 45, wherein said directing means includes three mirrors comprising an "L shaped" arrangement.

57. The laser system according to claim 45, wherein the nonlinear crystal is based on a doubly-resonant oscillator.

58. The laser system according to claim 45, comprising a pair of said nonlinear crystals pumped by said laser source means with interlaced beams whereby an overall repetition rate of at least 20 Hz is achieved.

59. The laser system according to claim 45, wherein the fluence onto the eye is between 100 mJ/cm^2 and 500 mJ/cm^2.

Add 65

add E4

add C1